The P-3 Orion at Forty

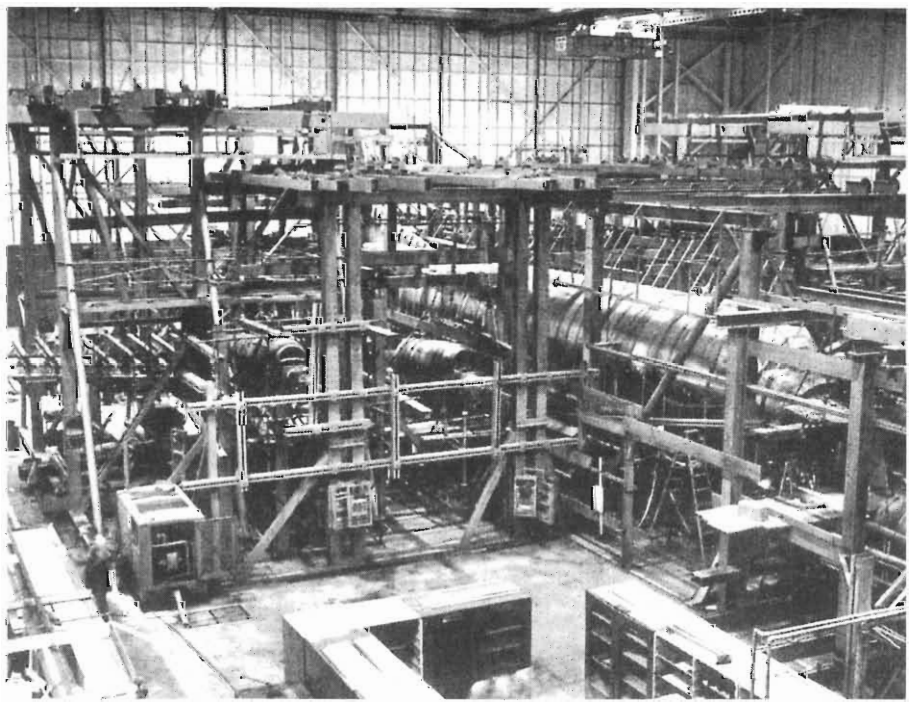
By David Reade

YP3V-1 Prototype Aircraft on Maiden Flight **(Lockheed via P-3 Publications)**

With the beginning of the new millennium, most pause to take stock and evaluate the potential for the future. But it is also a period that provides us an opportunity to look back to see how we got to where we are now, and from this, perhaps, learn from the past.

This is the case with the P-3 Orion. It was forty years ago that the YP3V-1 prototype Orion aircraft made its maiden flight. Development of this prototype and the P-3 in the intervening years is now having a profound effect on the aircraft's future. Factors affecting the Orion's original service life and those impacting on the future extension of its service life, have been related to the aircraft's manufacturing, and have prompted recent studies and programs to evaluate, sustain and extend the P-3's operational use far into 21st Century. The other effects driving the potential operation of the P-3 in the future are related to geo-political influences associated with changes within the last decade. The end of the Cold War with the former Soviet Union, the Gulf War with Iraq and the instability in the Balkans have combined to shape the future of the P-3 and missions it performs. Gone are the "blue water" ASW missions hunting for quiet nuclear submarines. Today, multi-mission capabilities are paramount, including maritime and littoral surveillance, over-land reconnaissance and real-time intelligence gathering. Technology has also had an influence on the missions performed by the P-3, adding digital imaging sensors, precision GPS navigation, satellite communications and the power of modern computer processors. Gone are the stand-alone operator/sensor stations. Now the keys to future operations are multi-functional workstations, data fusion and the ability to operate with combined forces.

The future of the P-3 is divided between two areas of concern, structural soundness of the airframe and mission-system upgrades. The P-3 airframe is an inherently fatigue-resistant structure, as proven by its extensive service history. The L-188 Electra, from which the P-3 was derived, is still in commercial service, having flown



The Original P-3 Fatigue Test Article Airframe **(Lockheed via P-3 Publications)**

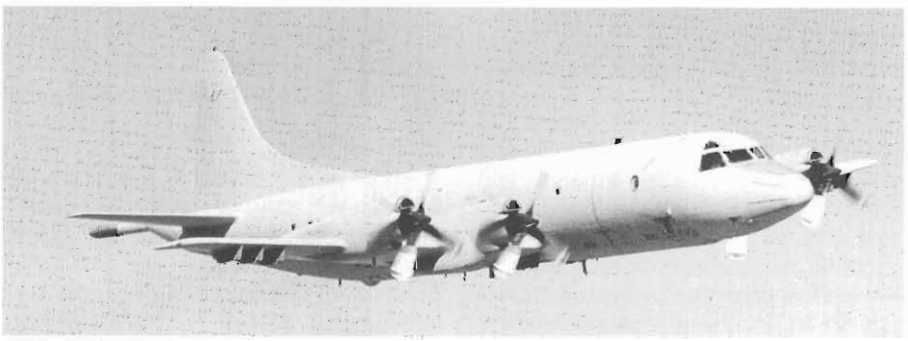
more than 50,000 flight hours. By comparison, the highest time P-3 airframes, Alpha and Bravo models, have less than 18,500 flight hours and 5,500 fuselage pressure cycles. The majority of the airframes have far fewer hours.

Overall, the worldwide P-3 fleet has recorded more than nine million total flight hours with no known cracks due to fatigue alone. But environmental and operational wear and tear, unique to the P-3, have had significant impact on the Orion's airframe. Corrosion has been discovered to be the principal culprit that is greatly affecting the operational readiness of P-3s worldwide. The US Navy, who established the original requirements for the P-3 in 1957, has pioneered the development of counter-measures to combat the effects of corrosion and in due course extend the operational service life of the Orion on the road towards the ultimate replacement of the aircraft in the future.

The US Navy has instituted a sequence of programs to recover the operational service life of the airframe, based upon the manufactures estimates; an assessment program to evaluate the airframe structurally to further extend the life of the aircraft and finally a program to implement those recommendations. Once the life of the aircraft has been extended 15 to 20 years, a replacement program will usurp the P-3 in the future.

The Sustained Readiness Program (SRP), was initiated in 1994 to address the high-corrosion areas of the P-3 that have had a significant impact on the operational service life of the Orions. The program preemptively replaced, upgraded and refurbished key structural elements to restore the aircraft's material condition and correct corrosion damage as a result of more than thirty years of continuous Maritime Patrol operations. SRP also addresses supportability issues that affect the aircraft's availability and upgrades several aircraft systems.

The SRP process encompassed the unprecedented disassembling of the aircraft, dividing the airframe up into four major components: empennage, wings, engine nacelles and main-tube fuselage, with each component subsystem refurbished separately. The replacement component parts were divided into "Core" and "Conditional" kits. Core kit items were installed on all the aircraft, while components of the conditional kits were used only as required depending upon the material conditions of each individual aircraft. Unfortunately, the first group of US Navy P-3s inducted into SRP were found to be in worse material condition than previously anticipated. Imperfections and procedures of the original manufacturing process permitted corrosion to do its destructive work, degrading the aircraft's material condition. This situation was further compounded by Navy maintenance practices over the years.



SRP P-3 **(Raytheon Systems Company)**

The situation caused by the advanced corrosion damage prompted considerable delays in the SRP program and prompted the need to utilize more Conditional Kit components, pushing costs beyond initial forecasts, and forcing the program into cancellation after only 13 aircraft were completed. The US Navy now views the SRP program, as originally conceived, no longer to be the best and most economical approach. The program became too time consuming at a period when the US Navy's P-3 Fleet was in a low state of readiness, when there were not enough airplanes in flyable condition to meet their operational commitments.

Cancellation or curtailing of the SRP program can be further attributed to a new aggressive naval aviation policy to establish an 11th Airwing for its fleet of carrier battle groups. This new 11th Airwing is prompting the cancellation of many proposed programs throughout naval aviation and constitutes a forty-five degree course change in policies developed over the last decade.

The SRP process did, however, prove the evasive dismantling of the P-3, and its refurbishment to flying condition was possible, and adds to the potential of future life extension and re-manufacturing programs. The current ongoing Service Life Assessment Program (SLAP) combines structural data from the original P-3 Fatigue test article airframe, structural data recorder (SDRS) information (installed on most Orions), SRP rework, PDM Maintenance and an airframe tested-to-destruction project, to determine the Orion's true fatigue-life condition. All the structural data collected is then utilized to create preventative measures to extend the service life of the P-3 to 2020, when an expected P-3 replacement aircraft is to enter naval air service. The scope of the SLAP program was recently increased to include extending the service life of the US Navy's EP-3E ARIES II. The program will now have to determine what components are needed for both the P-3C and the EP-3E. The SLAP recommendations to the Navy are eventually to be implemented in a service life extension program or SLEP.

The US Navy's P-3 replacement program has been designated MMA for Multi-mission Maritime Aircraft program. MMA, as originally projected, was to be a replacement platform for several Navy aircraft including the C-130 transport and E-6 strategic communications aircraft as well as the P-3C Orion and now the EP-3E ARIES II. Upwards of 251 planes were planned. An MMA Concept Study was conducted in 1999 to evaluate a variety of single-platform options including a 737 variant, C-130J Hercules or new production P-3 and a re-manufactured P-3. The findings of the study led to the Navy issuing a tentative endorsement of a re-manufactured P-3 as the best value solution to replace the P-3 and EP-3E. The current short-term budgetary constraints and high costs do not

support the acquisition of a new production military variant or commercial derivative platform.

The MMA program now proposes to re-manufacture existing P-3 airframes, dismantling the aircraft into major components for refurbishment. The program is to include new structural components: empennage, wings, new modern-technology engines and advanced avionics. The MMA Aircraft is also expected to include aerial refueling, command/control/communications/computers and Intelligence (C4I) capability, and stand-off strike weapons and electronic warfare mission capabilities.

Since the cancellation of the SRP Program, the US Navy continues to proceed with the P-3 SLAP program and seek funding to establish a P-3 SLEP program. The Navy has stated that the cancellation of SRP will not affect SLAP, but could influence which component parts would go into the eventual SLEP Core component kits. SLEP is still expected to begin 2002 with the first SLEPed aircraft to enter fleet service by 2007. If SLEP can't be funded, approximately thirty to forty P-3s will have to be withdrawn from service by 2006. The P-3 MMA program is now possibly delayed by several years. The first full MMA equipped squadron is now expected to enter service in 2015. The first squadron is to receive ten aircraft configured for MPA with another seven aircraft provided for surveillance and intelligence collection and two more for pilot training.

P-3 Mission Systems Upgrades

Recent years have seen considerable development in Maritime Patrol aircraft worldwide. MPA aircraft have become the universal surveillance platform of choice for many NATO and non-aligned nations who are also trying to do more with dwindling budgets. With most of the international MPA platforms aged beyond thirty years, and some with mission system technologies of 1960's vintage, replacement and or modernization programs are under development to support continued operations for the next thirty years. Few of these programs encompass new-development aircraft. The majority result from modernizing existing platforms either through structural refurbishment and mission systems upgrades or through acquisition of surplus airframes and modernizing them. In any case, a new era of MPA aviation is at hand with numerous improvement programs in progress or under development for the P-3.

RAAF AP-3C Maiden Flight **(RAAF / Raytheon Systems Company)**

One of the most significant P-3 mission system upgrade programs to be established in recent years has been the "Sea Sentinel" upgrade for the Royal Australian Air Force's fleet of P-3, now designated AP-3C. The Sea Sentinel refurbishment program, initiated in 1995, was to reduce aircraft weight as part of a planned life-extension process. To accomplish this the RAAF selected the integration of newer, lighter more sophisticated mission systems and sensors. The program replaces older, heavier, less capable and insupportable mission sensors, avionics and equipment that represent most of the 3200-pound reduction mandated by the requirements. The new aircraft systems and sensors are much lighter, thus reducing the impact on the airframes fatigue life index. New replacement mission-system components include a new data management system, modern multi-mode radar, advanced communications and navigation systems as well as a sophisticated acoustic-processing system. Additional modifications to the aircraft include an electronic flight instrumentation system (EFIS), or glass cockpit, with an associated flight management systems and a new tactical compartment layout incorporating new light-weight, multi-functional sensor-operator workstations.

AP-3C new interior arrangement **(RAAF / Raytheon Systems Company)**

The Sea Sentinel AP-3C is the first

P-3 to be equipped with multi-functionality to reconfigure each workstation to any of the sensor operators' positions, thus providing the ability to reconfigure the aircraft specifically tailored for a particular mission. The new multi-functional workstations consist of ruggedized color, high-resolution displays and modern data-entry panels, keyboards and track-ball controls - that are integrated into a new lightweight console chassis.

Performed by Raytheon Systems Company, the first Sea Sentinel aircraft made its maiden flight on May 19, 1999. As the first aircraft neared completion, preparations were begun for the modification of the remaining fleet of aircraft in Australia at Raytheon's primary sub-contractors (Boeing/Asta) in-country facility utilizing RSC designed kits.

The AP-3C mission system suite was designed with built-in growth and supportability to enable the aircraft to operate far into the 21st century. Currently, the AP-3C is the most sophisticated MPA P-3 in the world.

AP-3C multi-functional workstation (RAAF / Raytheon Systems Company)

Another of the P-3 upgrades underway for the last few years has been the US Navy's AIP program. The ASUW Improvement Program, although often viewed as a mission system upgrade, is really a mission-capability upgrade, adding an improved ASUW capability to the existing mission suite. This is accomplished through the installation of new and upgraded mission sensors. The AIP program included a new APS-137(v)5 ISAR, new FLIR sensor, SATCOM communications, AAR-47 missile warning system and the ALE-47 chaff / flare counter-measures-survivability system. The program also adds the OASIS tactical information system and the AVX-1 Cluster Ranger electro-optical surveillance sensor to the existing Update III configured mission suite. AIP also upgrades several existing systems including a new DF antenna fit for the aircraft's ALR-66 ESM and an associated pulse analyzer, new universal displays and controls at several sensor-operators positions and an upgrade to the existing CP-2044 mission computer to interface the new systems and sensors. AIP also upgrades the aircraft's Harpoon missile system to provide for the launching of the Stand-off Land Attack Missile or SLAM. The SLAM upgrade also provides launch and control capabilities for the Maverick missile. Out of 68 aircraft projected to be upgraded with AIP, to date, 23 have been delivered.

Norway is another P-3 operator that is a recipient of the AIP program for its P-3C Update III. Known as the Upgrade Improvement Program or UIP, the program improves the ASUW capabilities of the Norwegian Orions while improving the ASW capacity of the aircraft. Based on AIP, the Norwegian UIP includes the installation of the CP-2044 computer, the APS-137B(v)5 imaging radar, electro-optical surveillance system sensor, GPS Navigation and SATCOM communication as well as a new acoustic-processor and receiver system. Additionally, the aircraft's ESM system is upgraded and encompasses a dedicated ESM operator station positioned across from the existing sensor #3 operator. Other UIP improvements to the aircraft includes a chaff and flare-dispensing counter-measures system and a radar/laser warning system for self-defense. The first Norwegian UIP aircraft has been delivered, with the remaining three aircraft currently undergoing modification with deliveries scheduled throughout 2000.

The Dutch have also expressed a desire to receive a version of AIP for its Capabilities Upkeep Program or CUP. Proposed for several years, the Royal Netherlands Navy has recently weathered a series of defense budget cuts, re-evaluations and proposed base closings to finally establish a P-3 upgrade program. Based in principle on the AIP program, the Dutch CUP program is closer to the scope of the Norwegian UIP upgrade. The CUP will improve the RNLN P-3 Orion's ASUW capability while upgrading the acoustic suite of their older P-3C Update II$^{1}/_{2}$ aircraft and provide a level of standardization and interoperability with the US Navy *(even though today, interoperability is more related to technology of modern systems rather than commonality of systems).*

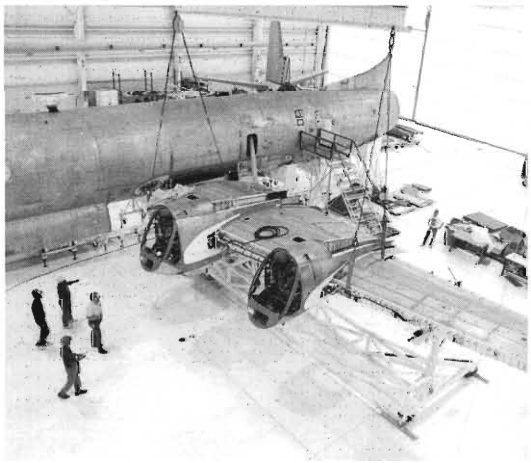
The CUP is expected to encompass a new multi-mode ISAR/SAR radar, GPS navigation, SATCOM and secure link communications as well as a new infrared sensor and self-defense systems. The CUP is also to upgrade the aircraft's older acoustic suite, provide cockpit enhancements and a new data-management mission computer. Some of the RNLN P-3s have already received a new STAR SAFIRE infrared /electro-optical sensor, AAR-47 missile warning system and a ALE-47 counter-measures dispensing unit for recent operations in Kosovo. The CUP is to completely upgrade 7 of the RNLN's 13 P-3C Update II$^{1}/_{2}$, while another three aircraft will be partially equipped for special surveillance missions in the Caribbean. The three remaining Dutch P-3 aircraft are to be sold.

As the 20th Century was coming to a close, several P-3 operators announced the establishment of upgrade programs with the selection of contractors to perform the work. Since the mid-1980's the Spanish Air Force has vied for a mission systems upgrade for its fleet of P-3A/B Orion aircraft. These P-3s possess the mission systems technology of the 1960s. Spain initiated a P-3 upgrade program in 1987, only to have budget cuts reduce the scope of the potential program to a piecemeal, system-by-system project. In more recent years, with the advent of advances made in Spanish industry, a comprehensive modification program was initiated encompassing a new data-mission system and host of sensors developed by Spanish Aerospace companies. CASA, taking the lead, will integrate its new fully integrated tactical system or FITS into the SAF P-3 to merge state-of-the-art mission systems.

Since the cancellation of the second phase of the Rigel project in 1990, due to government imposed military budget cuts, the Royal New Zealand Air

Force has striven to initiate a modernization program to upgrade its six P-3K Orions. Several service life assessment studies have identified aircraft deficiencies and outdated and obsolete system/sensor supportability issues. One of the areas studied was the fatigue index of the aircraft and the means to extend their service life. This prompted the establishment of Project Kestrel, a program to replace the wings, horizontal stabilizers and other fatigue critical items. The program commenced in 1996 with the maiden flight of the first Kestrel P-3K in 1998. The sixth P-3K is expected to be completed by the end of 2000.

With the airframe guaranteed through 2030, further studies established the need for a new state-of-the-art mission suite to replace the existing obsolete technology. Known as Project Sirius, the RNZAF established requirements for a complete mission-systems upgrade for their P-3K in 1999. The proposed upgrade is to include a new digital-imaging radar, advanced ESM, new acoustic processor, IR/EO surveillance sensor and a new digital MAD. The RNZAF is also looking to upgrade the navigation and communications suite with secure data link as well as a self-defense capability and a modernized cockpit. At the heart of Project Sirius is a modern, fully-integrated, state-of-the-art data mission system (computer) with multi-functional workstations and high-resolution color displays and controls.



SRP Program, Wing Removal (Raytheon Systems Company)

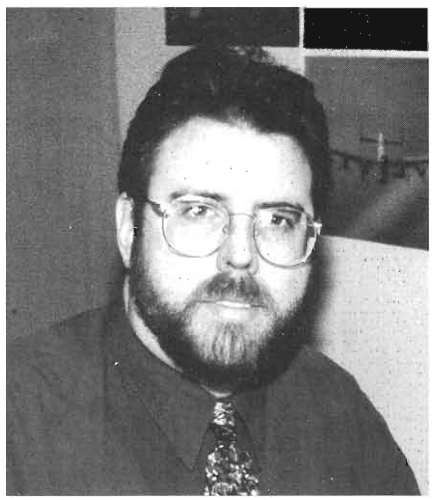
Project Sirius is a significant step forward for the Kiwi P-3 Fleet, introducing new capabilities that will fundamentally change air operations in the future and interoperability with other defense neighbors and those around the world. The New Zealand MOD recently selected Raytheon Systems Company for Project Sirius as the preferred vendor. At the heart of the mission system is Raytheon's Integrated Data Handling System or IDHS. The IDHS is a fully distributed, open-architecture, mission computer that utilizes commercial-off-the-shelf, NT Windows-based computing software and hardware components. The IDHS provides advanced controls and integration capabilities for MPA platforms. It provides very flexible, reconfigurable and customizable user interfaces that enhances crew performance and situational awareness. This coupling of state-of-the-art mission system and advanced sensors, will establish the RNZAF P-3K as the most sophisticated and capable P-3 aircraft in the world when completed.

As the dawn of the new era is at hand, other international P-3 operators are in the process of establishing their own P-3 upgrade programs. With the cancellation of Canada's Aurora Life Extension Project (ALEP) in June 1997, due to financial constraints, a re-evaluation was undertaken that later prompted implementation of the ALEP initiatives in a phased program incrementally over a ten year period. The new Aurora Incremental Modernization Project (AIMP) encompasses the original ALEP improvements for a new data-management system, advanced imaging radar, acoustic processor, a new MAD, new ESM and installation of an electro-optical system as well as self-defense package. AIMP also plans for new navigation and communications systems incorporated into a new upgraded cockpit. In the meantime, Canada is trialing a new 99-channel sonobuoy receiver, a modern digital camera and a civilian SATCOM system. Canada is also pursuing an agreement with the US Navy to participate in their P-3 SLAP program.

Portugal is another P-3 operator that is currently developing an upgrade program for its fleet of six P-3P Orions. The Portuguese P-3 upgrade proposes to structurally upgrade the airframe as well as improve the aircraft's mission suite. The scope of structural upgrade to the P-3 airframe is expected to be much like those proposed by US Navy's P-3 structural programs. The mission system is to include new maritime-surveillance sensors, modern navigation and communication gear, and a new state-of-the-art data-mission system. The proposed P-3P upgrade will support the Portuguese Orions service life and mission capability far into the future.

As P-3 operators strive to prolong the service life of their aircraft, the international aerospace industry will be there to meet the challenges of keeping the P-3 viable in the years ahead. There are currently more aerospace companies involved producing advanced systems, sensors, structural components and engineering capabilities to sustain, extend and upgrade the P-3 than ever before, even more than those producing new replacement aircraft. It is now clear that the P-3 Orion will endure in the future and become the multi-mission Maritime Patrol platform of choice far into the 21st century. ✈

About the Author



David Reade is a freelance journalist and consultant. He has written numerous informative articles on the P-3 Orion, its sytems, missions and capabilities for over 10 years as a staff writer associate with Lockheed Martin's ASW Log and Airborne Log magazines. He is also a regular contributor to VP International's Maritime Patrol Aviation magazine. He has flown P-3s all over the world and is considered a leading authority on the aircraft. It is this experience and knowledge that led David to complete "The Age Of Orion". David currently resides in Nova Scotia Canada.